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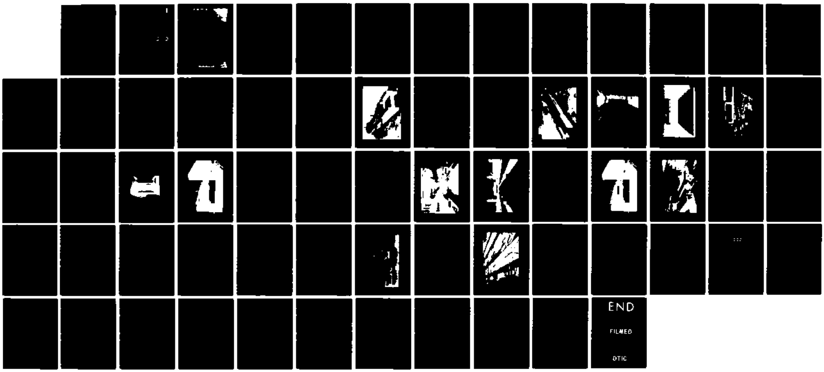

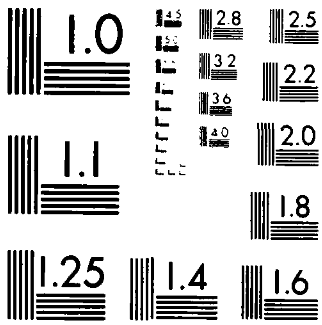

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REPORT ON THE CANCELLED SEABEE PRETEST OF THE JOINT
LOGISTICS-OVER-THE-SHORE (LOTS)
TEST AND EVALUATION PROGRAM

15 June 1977

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Container	DeLong "B" Barge	Hoist
Container Adaptor Frames	Deployment	Lighterage (Cont.)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The primary objective of the SEABEE pretest was to determine the capability of the Services to use the vessel for deploying selected heavy, outsized LOTS equipment to a site where fixed port facilities do not exist. The SEABEE is the only ship with the designed lift potential to deploy the DeLong B Barge either alone or with the 300-ton capacity crane as a temporary containership discharge facility (TCDF).

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19. Key Words (Cont.)

Logistics-Over-The-Shore	SEABEE	TCDF
LOTS	Snubbers	Temporary Container Discharge Facility
Merchant Ships	Stowage	
Outsize	Structural	Transporter
Pedestals	Synchronization	Winch

20. Abstract (Cont.)

A modification to the ship's two SEABEE barge transporters is required for handling DeLong barges. In order to move the large DeLong barges, both transporters would have to be synchronized. The design and fabrication of such a kit appears feasible within current commercial capabilities.

The compatibility of the SEABEE's equipment handling system and the candidate LOTS equipment was the main area of interest. The gross tonnage of each individual item of equipment was well within the designed capacity of the ship's elevator and barge handling equipment. However, the unsymmetrical weight distribution of the longer loads on the elevator and the forces imposed on the loads themselves, required a detailed analysis.

Container adaptor frames, intended to add a container handling and transport feature for the ship, are suitable for providing the required support for the LOTS equipment which is not compatible with the ship's barge handling system.

The SEABEE pretest, initially scheduled during 1976, was to include loading most of the heavy, outsized LOTS equipment. When the ship could not be made available for a full scale pretest, the scope was reduced to chartering a ship for one day in a normal Gulf port of call. Only the largest, heaviest items, an LCU and a DeLong "B" barge were to be lifted. However, in response to a bid proposal for the charter the ship owners, the Lykes Brothers Steamship Company, decided not to permit lifting the DeLong barge because of currently imposed limitations on the barge elevator hoisting mechanisms. A payload limit of 1,200 long tons had been imposed instead of the designed lift capability of 2,000 long tons because of defects discovered in the elevator system. Since the LCU can be deployed by other merchant ships, it was concluded that the test would be of marginal benefit and it was therefore cancelled.

The events and planning in preparation for the SEABEE pretest show that the Services do not now have the capability of deploying the DeLong "B" barge except by towing. The potential for deployment by SEABEE ship can only be established after the limitations now in force for the ships have been lifted. There were also indications from preliminary load planning that both the ship and LOTS equipment to be deployed would require some modifications to make compatible loads. The details of this planning and preparation are contained in this report.

ABSTRACT

The primary objective of the SEABEE pretest was to determine the capability of the Services to use the vessel for deploying selected heavy, outsized LOTS equipment to a site where fixed port facilities do not exist. The SEABEE is the only ship with the designed lift potential to deploy the DeLong B Barge either alone or with the 300-ton capacity crane as a temporary containership discharge facility (TCDF).

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I. INTRODUCTION

BACKGROUND

This report describes the planning, preparations, and operational procedures that were to be used in the preliminary field test (pretest) of a bargeship (SEABEE) deploying selected items of LOTS equipment. The reasons for cancellation of the test are also discussed.

Since 1965, newer classes of ships have been constructed, some of which have incorporated innovative cargo handling concepts, including the SEABEE ship. Because adequate, reliable data concerning the suitability of certain ships to deploy newly acquired LOTS equipment were generally lacking, a series of preliminary field tests was proposed prior to the LOTS main test.[1] These pretests were designed to validate the feasibility of deploying the most difficult LOTS equipment on the available types of ships. The results of these pretests would then be used in the refinement of procedures and techniques and preparation of the LOTS main test design.

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[1] Operations Research, Inc., Design of Preliminary Field Tests for the Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 993, 6 January 1976.

The SEABEE pretest plan visualized the loading and unloading of the largest and heaviest LOTS equipment without major disassembly of components (Table 1). Although there are only three SEABEE ships in service, their unique heavy-lift capabilities made them an important element of the LOTS deployment evaluation.

TABLE 1

SEABEE BARGESHIP PRETEST RECOMMENDED LIST OF SELECTED LOTS EQUIPMENT FOR TEST LOADING

Item	Length (Ft)	Width (Ft)	Height (Ft)	Weight (LT/ST)
DeLong B Barge	150	60	10	436.8/489.3
LCU (1466 Class)	119	34	17.75	180/201.6
LACV-30	76.25	33	21.5	27.7/31
300-Ton Capacity Crane*	73	12	13.5	158/177
3 x 15 Causeway	90	21.25	5.1	60.3/67.5
LCM8	73.5	21	14	58/65
LARC-LX	62.5	26.6	15.33	88/98.6
Barge/Crane**	150	60	28.5	656/735

*To be positioned on the DeLong "B" Barge both during lift and stowage.

**Includes weight and height of the crane support foundation.

The SEABEE is a most versatile merchant ship for use in a military operation. Its self-sustaining potential both in-port and off-shore satisfies the requirements for sealifting military contingency supplies and equipment to a LOTS operating environment.

LOTS deployment requirements are primarily characterized by the necessity for a ship to have sufficient lifting capacity and stowage space to accommodate outsized equipment. The DeLong "B" Barge is larger and heavier than most combat equipment. It is specifically mentioned because of its importance

as a floating platform the 300-ton capacity crane when used as a temporary containership discharge facility (TCDF) alongside a ship and as a pier for container operations on the beach. The DeLong barge cannot be deployed overseas in a timely manner unless a SEABEE is capable of embarking it. The only proven mode of deploying the DeLong barge is by towing at a rate of 4-5 knots. For the most part, barges with large cranes mounted on them are not very seaworthy and the equipment incurs prolonged salt water exposure, considerable motion stress on the barge, and inadequate maintenance support while in tow. Thus, the towing transit time and the equipment's condition upon arrival create a less than desirable readiness situation.

SEABEE PRETEST SCHEDULE

Initially the SEABEE pretest was scheduled to be conducted during April 1976 with the following month as an alternate.[2] This time was set with the knowledge that the limited number of ships would significantly dictate their availability. In fact, a SEABEE could not be scheduled during this time.

In May 1976, the scope of the SEABEE pretest was greatly reduced. Plans were formulated to have the vessel embark an LCU and a DeLong barge at some Gulf port to be determined in negotiations with the Lykes Company, and then immediately after the equipment placement and tie-down, to disembark the equipment. Accordingly, the time period from October 1976 to February 1977 was selected as a "window" during which the SEABEE pretest could be conducted at one of its normal Gulf ports of call. The LOTS equipment to be embarked would be prepositioned at the port.

Pretest preparation and test events scheduled prior to and during the ship charter included:

- The preparation of the DeLong "B" barge. Alterations were to be made, if necessary, so that it could be

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[2] Operations Research, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, ORI Technical Report No. 913, 30 April 1975.

loaded on the ship's elevator, transporters, and deck stowage areas.

- The emplacement of weights to simulate the 300-ton capacity crane.

- The preparation of special equipment modifications. Alterations were required on the container adaptor frames in order to load both the LCU and the DeLong barge.

- The towing of the DeLong barge and deployment of the LCU to the loading port.

- The acquisition and prestaging of all necessary rigging, cribbing, dunnage, etc., for stowing equipment aboard the ship.

- The loading, stowing, and unloading of the candidate LOTS equipment.

TEST CANCELLATION

On November 15, 1976, the Military Sealift Command submitted a Request for Proposal (RFP) to the Lykes Brothers Steamship Company. The RFP requested a SEABEE ship for a one-day in-port trial involving the loading of a DeLong barge and one landing craft.

During a visit of Joint LOTS Test Directorate personnel to the Lykes Brothers Steamship Company on November 30, 1976, it was learned that the company would not agree to load the DeLong barge with a crane on the ship. The ship's owners, builders, and others were involved in a litigation because of problems with the ship's elevator hoisting mechanisms. The elevator is currently restricted to a 1,200-long ton lift for normal barge operations and unusual lifts like the DeLong barge with a crane will not be attempted.

On December 6, 1976, Lykes responded to the RFP in the negative pending the conclusion of definitive studies on the elevator. The company gave no forecast on the completion of the studies. Based on this uncertainty and the unlikely availability of the vessel prior to the main test, the SEABEE ship pretest was cancelled.

II. SHIP CHARACTERISTICS

GENERAL

Normal SEABEE operations can involve the transport of up to 38 SEABEE barges. Twenty-foot and forty-foot containers can also be stacked on the hatch covers of those barges stowed on the upper deck. Other containers can be accommodated on the upper deck with the installation of container adaptor frames (Figure 1). Table 2 lists some of the principal characteristics of the ship.

In order to assess the various components of the SEABEE barge and cargo handling system in relation to some of the LOTS equipment, an analysis of the structural, barge transporter, elevator, deck, and barge manipulation features is given. Some of the LOTS equipment can only be stowed on the upper deck. This is due to the size of the equipment. Loading procedures are treated in detail later in this report. The load bearing capacities of all the stowage decks are not a limiting factor since they exceed the design lift capacity of the elevator. Therefore, for the purpose of this report, all stowage decks were considered as having the same load bearing characteristics.

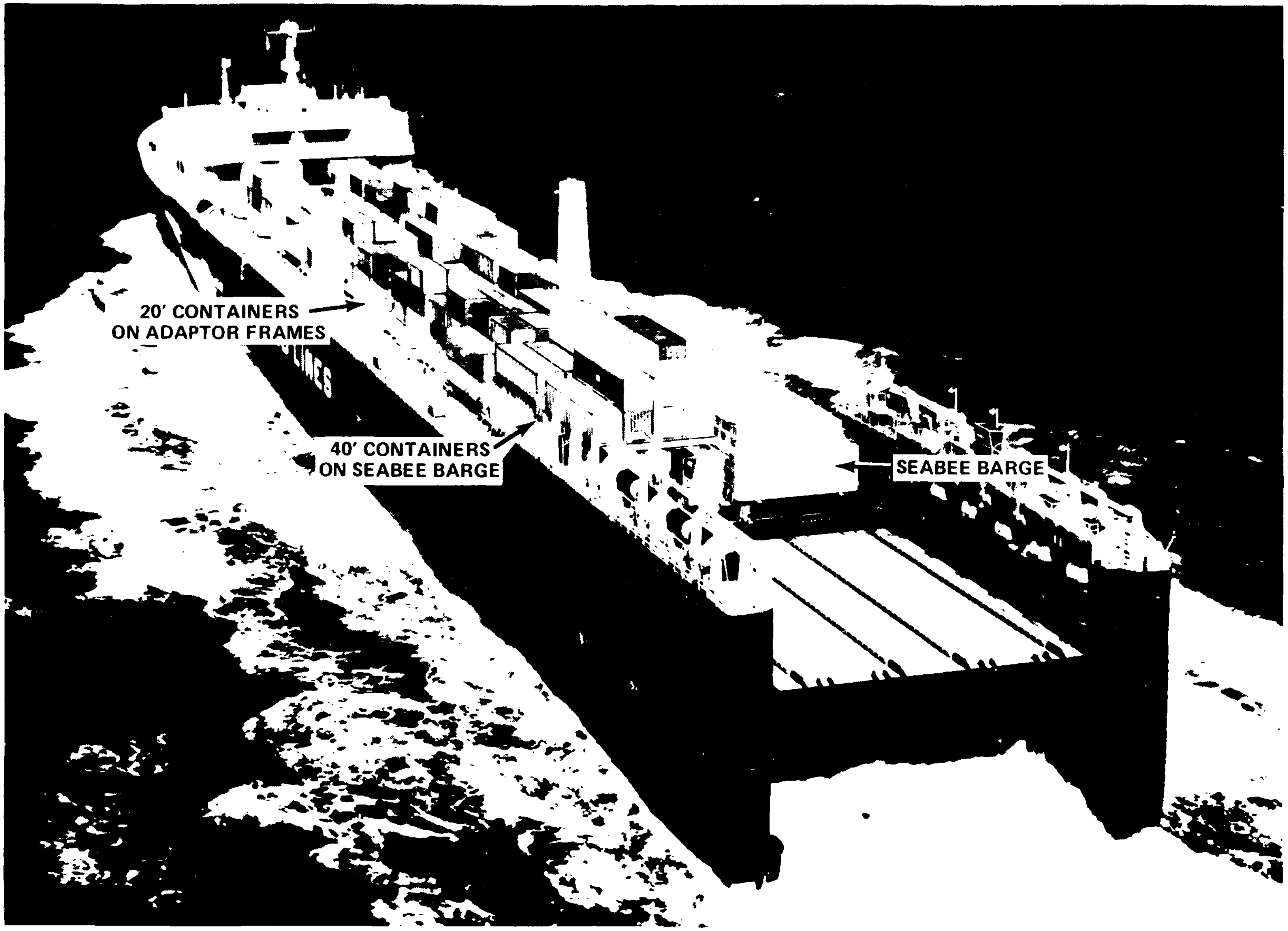

FIGURE 1. SEABEE VESSEL

TABLE 2

PRINICIPAL CHARACTERISTICS OF THE SEABEE

Vessel:	Type	C8-S-82a
	Length	874 ft
	Beam	106 ft
	Displacement (maximum)	51,000 LT/57,120 ST
	Design draft	32 ft - 8 in.
	Speed at design draft	20 knots
	Draft (maximum)	36 ft
	Speed at maximum draft	18.5 knots
Cargo Handling Equipment:	2,000-ton elevator at stern of ship is capable of handling loads of maximum width of 70 ft, a limiting draft of 12 ft, and a length limited only by a center of gravity location no more than 52 ft from either end of the load. Height of load is relatively unlimited for loads stowed on the upper deck. Height of loads for either the main or lower decks are limited to approximately 17 ft. 1,000-ton port and starboard winches position cargo fore and aft.	
Capacity:	SEABEE barges	38
	or	
	8 x 8 x 40 containers	812
	or	
	8 x 8 x 20 containers	1,784
	or	
	Liquid cargo	132,940 barrels
Elevator:	Platform length	104 ft
	Platform width	75.5 ft
	Lift capacity	2,000 LT/2,240 ST*
	Speed	4 ft/min
	Average cycle time	40 min.

* Currently limited by Company to 1,200 LT/1,344 ST.

STRUCTURAL

The SEABEE is designed to transport on its upper deck fourteen 97-ft, 1,000-ton barges (seven port and seven starboard (Figure 2)) on barge support pedestals (Figure 3). These supports bear on the transverse frames of the deck which, in turn, carry the loads imposed by the barges. If the TCDF, a DeLong "B" barge with crane (150 ft by 60 ft and weighing 656 long tons) is substituted for the SEABEE barge, it will be supported by these same barge support pedestals. This load of 656 tons will be imposed upon a deck designed to support 3,000 tons. Thus with the heaviest LOTS load equalling less than one-fourth of the designed load, all LOTS equipment loads are well within the structural strength limits of the deck.

The elevator platform (Figure 4) is designed to withstand a 2,000-long ton load imposed on the four rows of barge support pedestals. Even under the most adverse situation, the load imposed by the 656-ton TCDF is less than the designed load bearing characteristics of the platform. Since the hoisting mechanisms are designed to support the maximum elevator loads, they are capable of lifting any LOTS equipment.

BARGE TRANSPORTERS

The two barge transporters (one for each side of the ship) are designed to move barges to and from the elevator at any deck level. Each is driven by 24 self-propelled dollies (Figure 5) connected together on each side. A transporter is approximately 100 ft long and rides on double tracks with a separation of 16 ft between the outer rails. The transporter, which measures 16½ in. in height, can be driven under the barge which would be resting on 22-in. high support pedestals. When in position, each of the dollies is hydraulically jacked to a maximum height of 23½ in., thereby lifting the barges off their support pedestals. The transporter then carries the barge to its shipboard destination, i.e., stowage point or elevator, where it lowers the load onto another set of support pedestals. It should be noted that each transporter is operated independently.

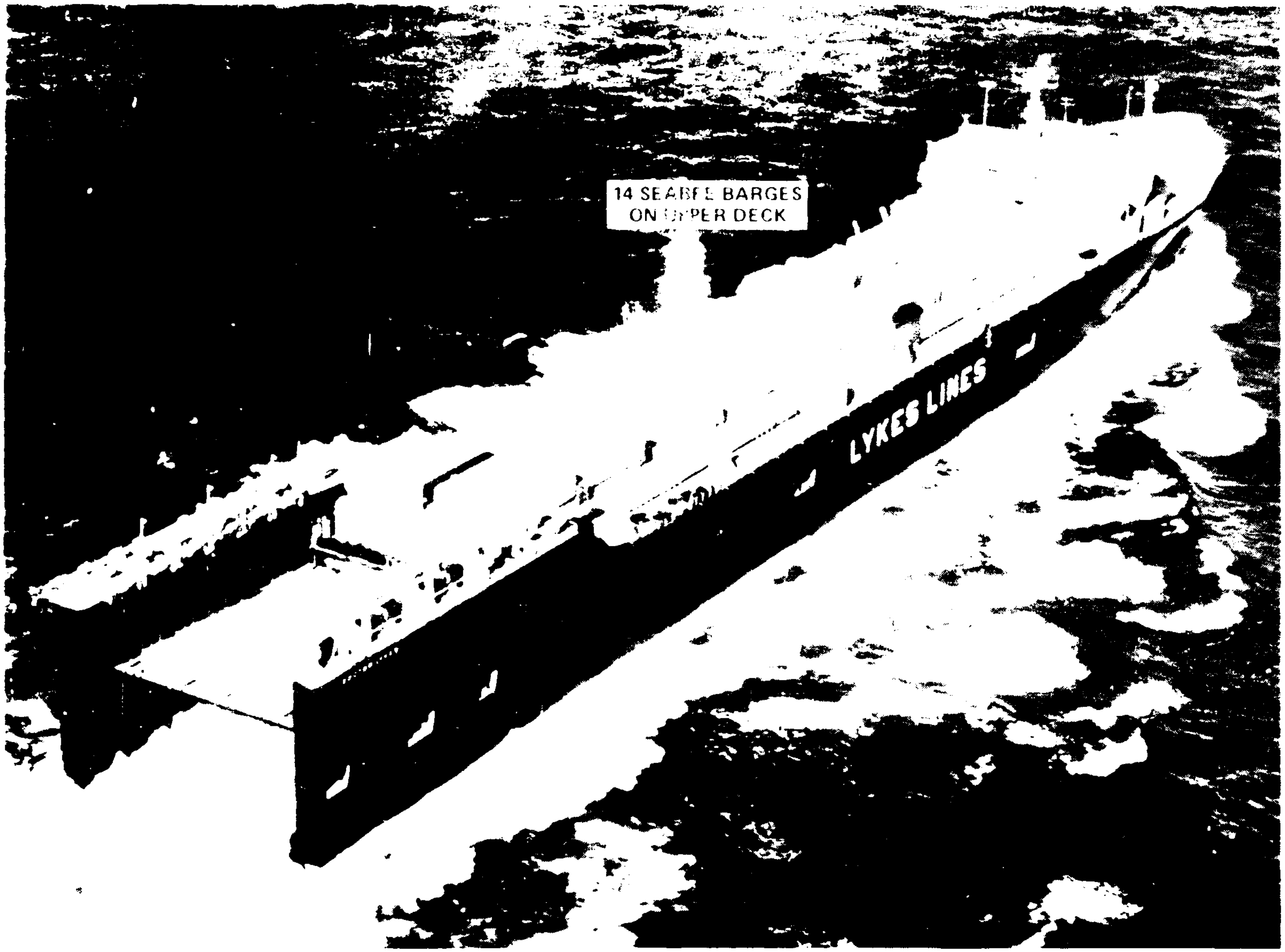

FIGURE 2. SEABEE VESSEL WITH MAXIMUM UPPER DECK BARGE LOAD

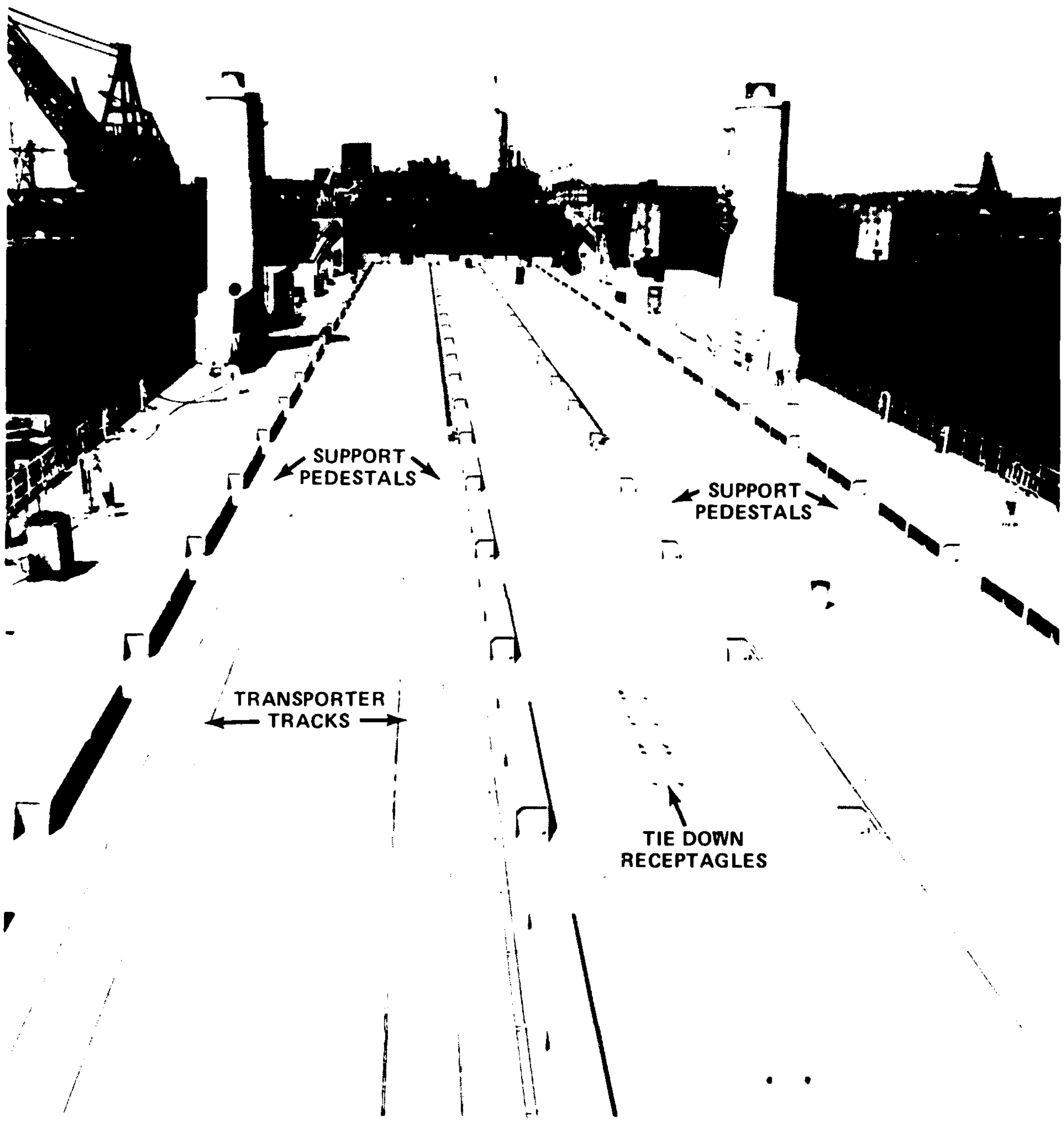

FIGURE 3. EMPTY UPPER DECK

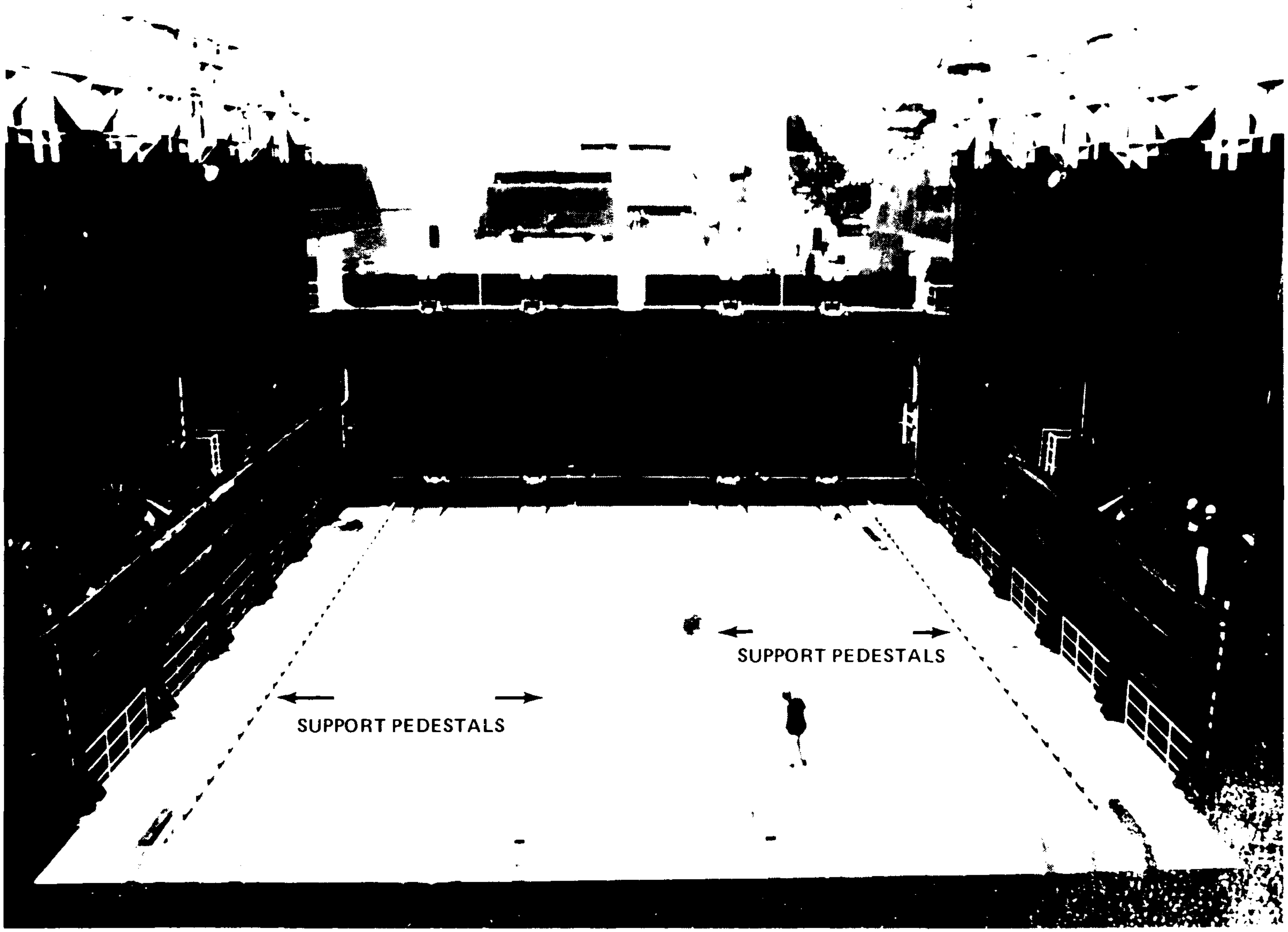

FIGURE 4. ELEVATOR

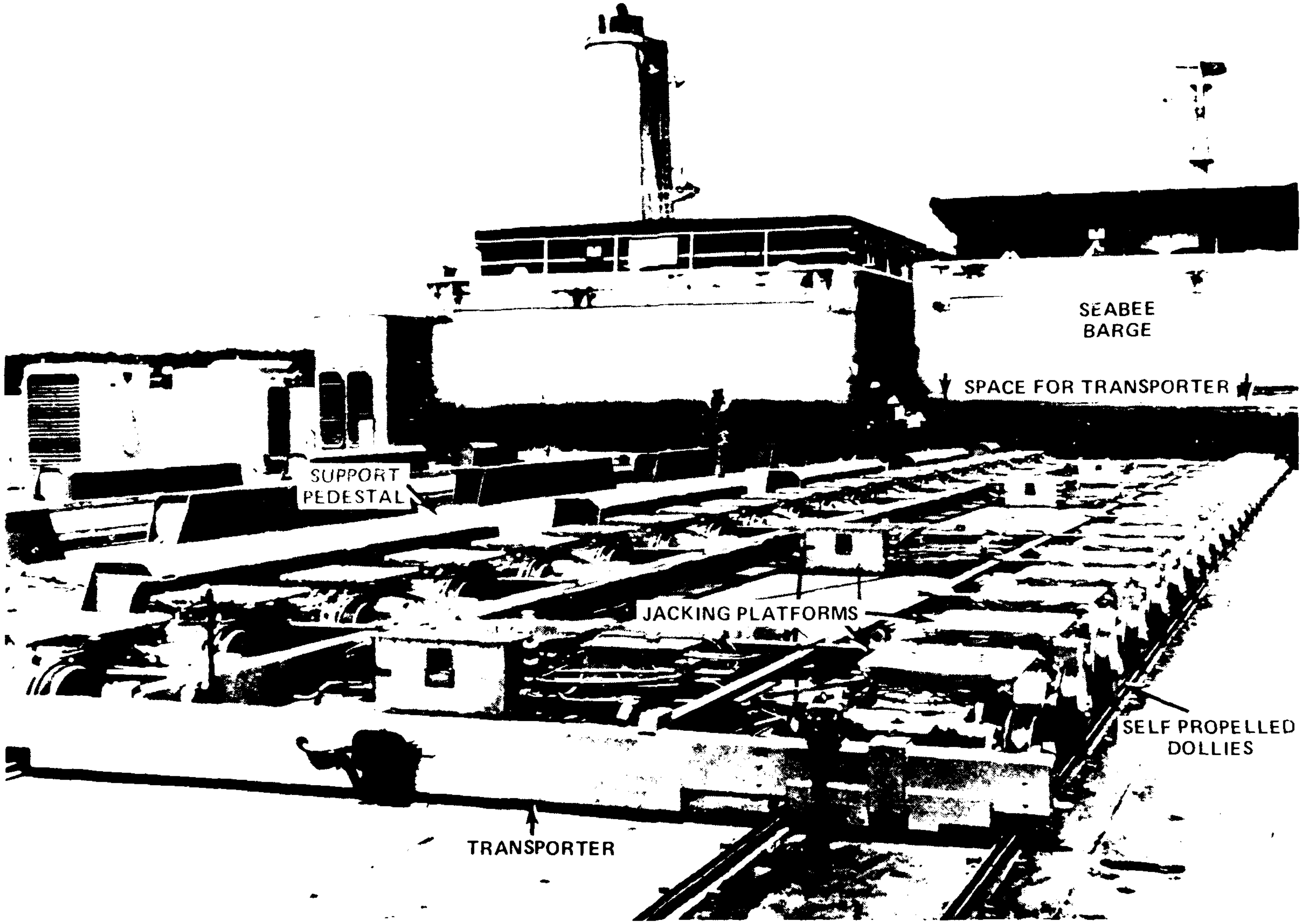

FIGURE 5. TRANSPORTER ON UPPER DECK

When positioned for moving the DeLong "B" barge from the elevator, the transporter is confronted with a unique situation. The crane/barge overhangs the transporter (Figure 6) at the aft end by approximately 50 ft. This overhang poses an unsymmetrical load on the transporter dollies and jacking system. The result is an imbalance on the lifting requirements for each of the hydraulic jacks. The uneven weight distribution was analyzed by means of a computer program[1] to validate the abilities of the transporter jacks to lift the jacking platforms and their imposed loads. It was noted that the jacks on the aft end of the transporter required a lift capacity of 41,800 lb. The remaining jacks were exposed to lesser weights. Since the maximum lift capacity of these jacks is designed at 68,000 lb, the uneven weight distribution on the transporter is well within acceptable limits.

The above analysis applies to only one transporter and is considered half of the total load. The lift requirement on the second transporter is identical due to the symmetry of the barge. Since both transporters will be required, their independent control features present another technical problem.

By design, the rate of transporter movement is governed by a rheostat which supplies the power to the drive motors. The power is controlled independently for each transporter, however, the TCDF lift requires transporter synchronization. To date, there have been no recorded instances wherein the transporters have been synchronized. General Electric Company designed and built the transporter control systems. It appears that the capability of industry to fabricate a synchronization kit is within the current "state-of-the-art." In addition to the synchronization circuitry, a new master control station would need to be installed. This station would provide the pushbutton switches for all the transporter control functions and would permit the control of both transporters simultaneously as well as separately.

ELEVATOR

The SEABEE elevator platform is composed of a single full width structure located between the wingwalls at the stern of the ship. An electro-hydraulic hoisting subsystem is designed to raise and lower the platform

[1] J. J. Henry Co., Inc., Feasibility Study for Shipping Crane Barges on SEABEE Vessel, 6 January 1976.

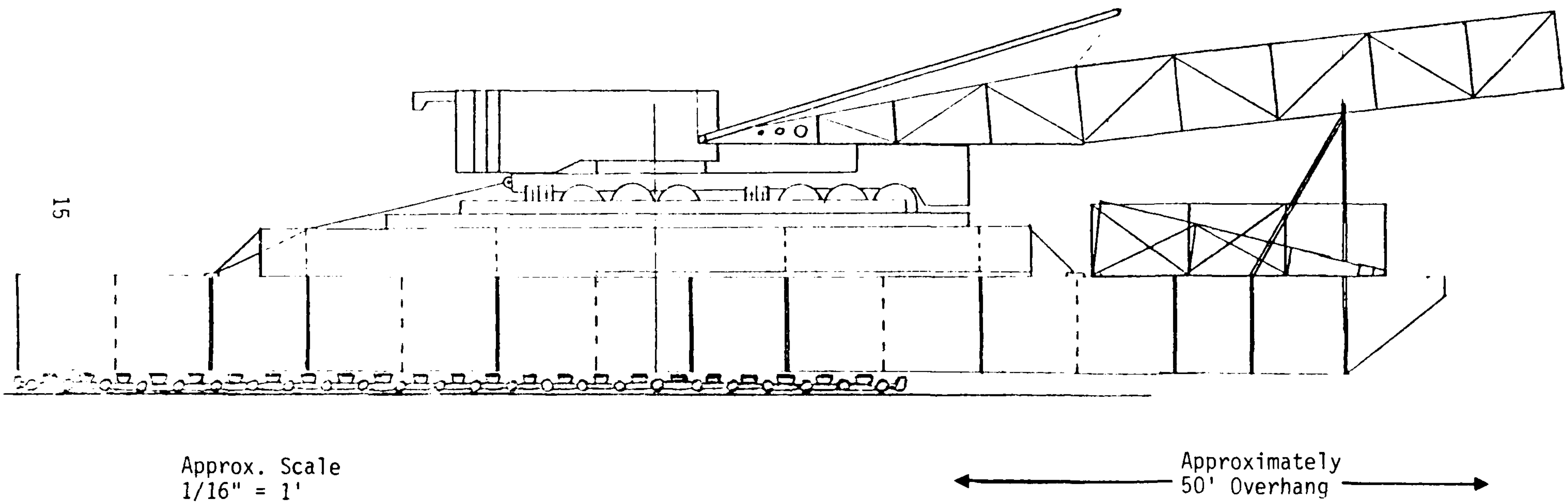

FIGURE 6. TCDF ON TRANSPORTERS

loaded with one or two SEABEE barges, between the water and any of the three stowage decks. The principal characteristics of the elevator system are provided in Table 3.

TABLE 3

ELEVATOR SYSTEM CHARACTERISTICS

Elevator Platform	
Length	104 ft - 3 in.
Width	75 ft - 6 in.
Depth	7 ft - 0 in.
Construction	Box Girder
Weight (with hoisting lines)	600 LT/672 ST
Hoisting Subsystem	
Number of hoists	12 (6 per side)
Hoist capacity	217 LT/244 ST
Lift rate at full load	4 ft per min.
Operating Characteristics	
Load capacity	2,000 LT/2,240 ST
Vertical travel	74 ft
Trim limits	
Bow down	10 ft
Stern down	7 ft
List limits	
Elevator Operations	5 degrees
Barge transfer to/from deck	3 degrees
Shock loads (maximum)	
Amplitude	± vertical travel
Period	7 seconds

NOTE: The center of gravity of a 2,000 LT load must be within a plus or minus 2 ft of the centerline of the elevator platform to avoid overloading one or more of the elevator hoists. Greater tolerances for lesser loads are acceptable.

The horizontal space between the transporter rails on the elevator platform and each of the stowage decks is spanned by make-up rails (Figure 7). The make-up rails are on a short platform hinged to the aft deck edge in the "up" position when they are not in use. This allows for the unobstructed movement of the elevator. When the elevator is in place at a particular deck level, the make-up rail platform is lowered to rest on the elevator. This affords a continuous transporter track from the elevator to the stowage deck.

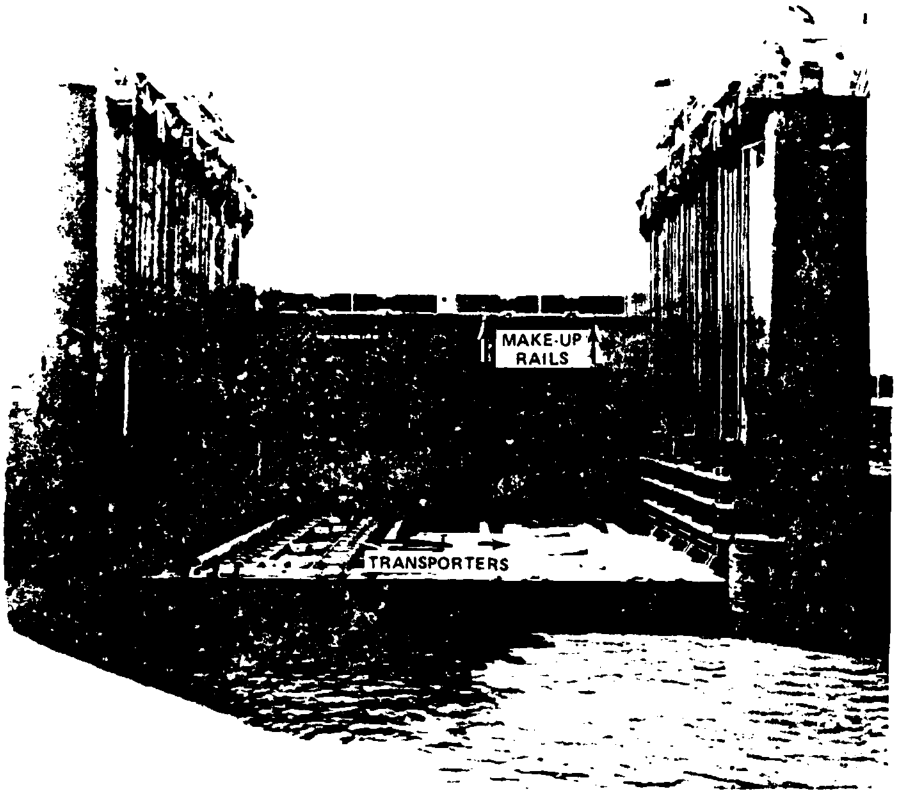

FIGURE 7. ELEVATOR

The elevator platform is raised and lowered by twelve pairs of hoisting cables attached to six double drum winches (Figure 8). There are three winches located on each out-board side of the platform on the top of the wingwalls. All of the winches are synchronized to provide a uniform rate of movement.

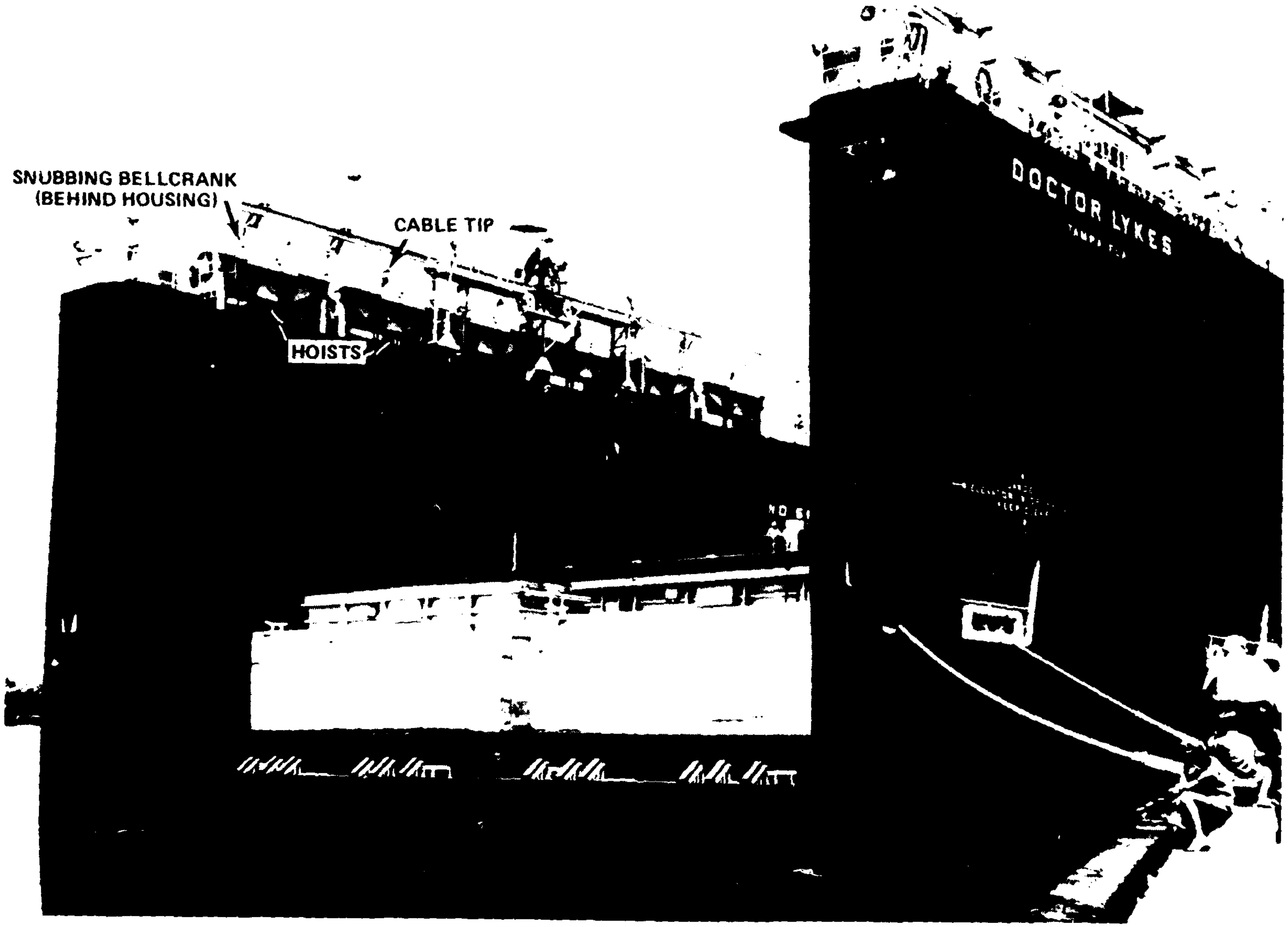

FIGURE 8. ELEVATOR HOISTS

As can be noted in Figure 9, each drum (Point A) has a pair of hoisting cables which are secured on a bellcrank at Point B. From here, the cables pass down to a triple pulley on the elevator (Point G) and then feed up onto a double hoisting pulley (Point H). After a series of turns between the pulleys, the cables terminate on the drum, each wire resulting in a six part pull.

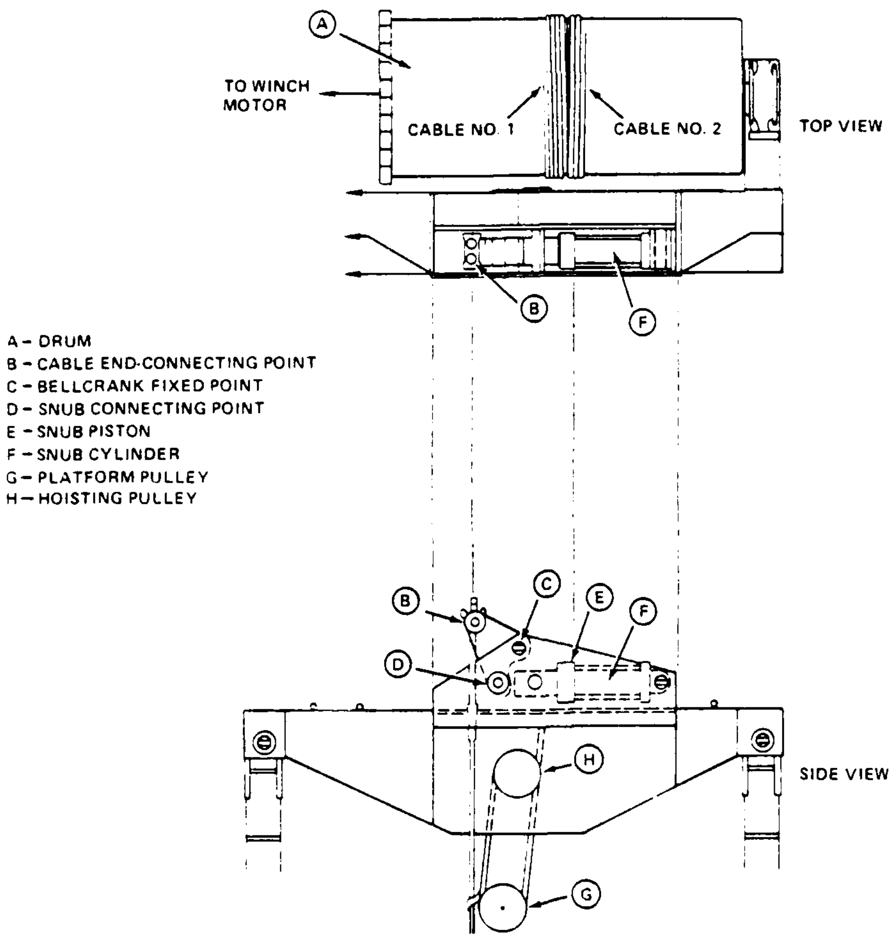

FIGURE 9. HOIST AND SNUBBING ASSEMBLIES

As previously noted, there is a bellcrank which moves about Point C. At Point D the bellcrank is connected to the snub piston head, Point E. The piston cylinder is located at Point F. When the hoisting mechanism is energized, each of the 12 snub pistons (E) are automatically extended under a hydraulic pressure of 1700 psi. As the piston is extended, it forces the bellcrank to rotate and raises the cable ends which are secured at B. It should be noted that all cable ends are in their highest position whenever the hoisting mechanism is energized.

If the maximum designed lift of 2,000 long tons were imposed on the elevator platform, and assuming a symmetrical weight distribution, each drum or hoist would be exposed to a vertical force of 488 kips[2] (488,000 lb). Hoist ratings are basically determined by the total elevator lift (weight of platform, hoisting wire, and payload) distributed equally among the 12 hoists. In this instance there is a 2,000-long ton payload and a 600-long ton elevator platform with associated equipment for a total lift requirement of 2,600 long tons (5824 kips). This equates to approximately 488 kips for each of the 12 hoists.

The vertical force required to activate the 1,700 psi in the snub cylinder is about 635 kips. This is computed as follows:

Snub piston diameter = 5.17 in.

Area of piston head = 84 sq. in.

Horizontal force = 84 x 1,700 = 142,800 lb

Piston connection point/cable end connection point to fixed point (on bellcrank) ratio = 1:1.35

$142{,}800 \times \frac{1}{1.35} = 105{,}778$ vertical force per pair of wires.

Since the wires are 6 part pull the total vertical weight needed to create an equilibrium = 6 x 105,788 = 634,667 lb (635 kips).

Whenever the vertical force exceeds the 635 kips limit, the cable end (B) will commence a downward rotation as the snub piston moves against the hydraulic pressure. As the cable ends lower, they essentially produce an effect of lengthening the cables thus reducing the imposed vertical forces. Meanwhile, the displaced load is shifted to adjoining cables and hoists.

Once the snub piston has fully displaced the hydraulic fluid and the cable ends are at their lowest position, additional vertical forces will then exceed 635 kips. Conversely, no equalization among the hoists takes place when the vertical force on each is less than 635 kips since the horizontal force on the snub pistons remains dominant and they remain fully extended.

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[2] Kips: Kilo-Pounds. One kip is a unit of weight equal to 1,000 lb deadweight load. It is frequently used to avoid possible confusion over weights in long or short tons.

A review of the compatibility of the planned LOTS loads with the elevator reveals two potential problem areas. The first concerned the ability of the elevator hoists to lift the imposed loads. This first problem would be applicable to all loads regardless of their length. A review of the weights of the planned loads confirmed that the imposed loads were within the designed capability of the elevator hoists. The second possible problem area, which is discussed in the next section for each candidate load, involves the ability of the load itself to withstand the bending moment forces imposed by the lift. This is particularly critical when the item to be lifted is longer than the elevator platform and the aft end is unsupported.

DECK

The general configuration of the stowage areas on the two lower decks is not similar to the upper deck (Figure 10). A longitudinal bulkhead separates each lower deck along the centerline of the ship. Each side of the bulkhead is approximately 35 ft wide and can accommodate SEABEE barges. The upper deck has approximately 20 percent more stowage space than either of the lower decks. However, there are numerous obstructions such as gear lockers, fire fighting stations, etc., that must be considered. All of these obstructions are located outboard of the transporter tracks (Figure 11).

As noted previously, the load bearing characteristics of each deck exceed the elevator lift capacity and can easily support any item that is loaded via the ship's elevator. The cargo deck loads are distributed by the four rows of barge support pedestals which bear on the transverse frames on the deck. The two outermost rows are located 31.167 ft from the deck centerline and the two innermost rows are located 7.5 ft from the centerline. The dimensions of these support pedestals are nominally 16 ft long, 19 in. wide, and 22 in. high.

There are numerous cleats recessed in the upper deck for securing equipment to withstand open sea conditions. All of these tie-down points have been engineered to support SEABEE barges. Their locations may not be suitable for the LOTS equipment, therefore, additional lashing points may be required.

FIGURE 10. LOWER DECK - LOOKING FORWARD

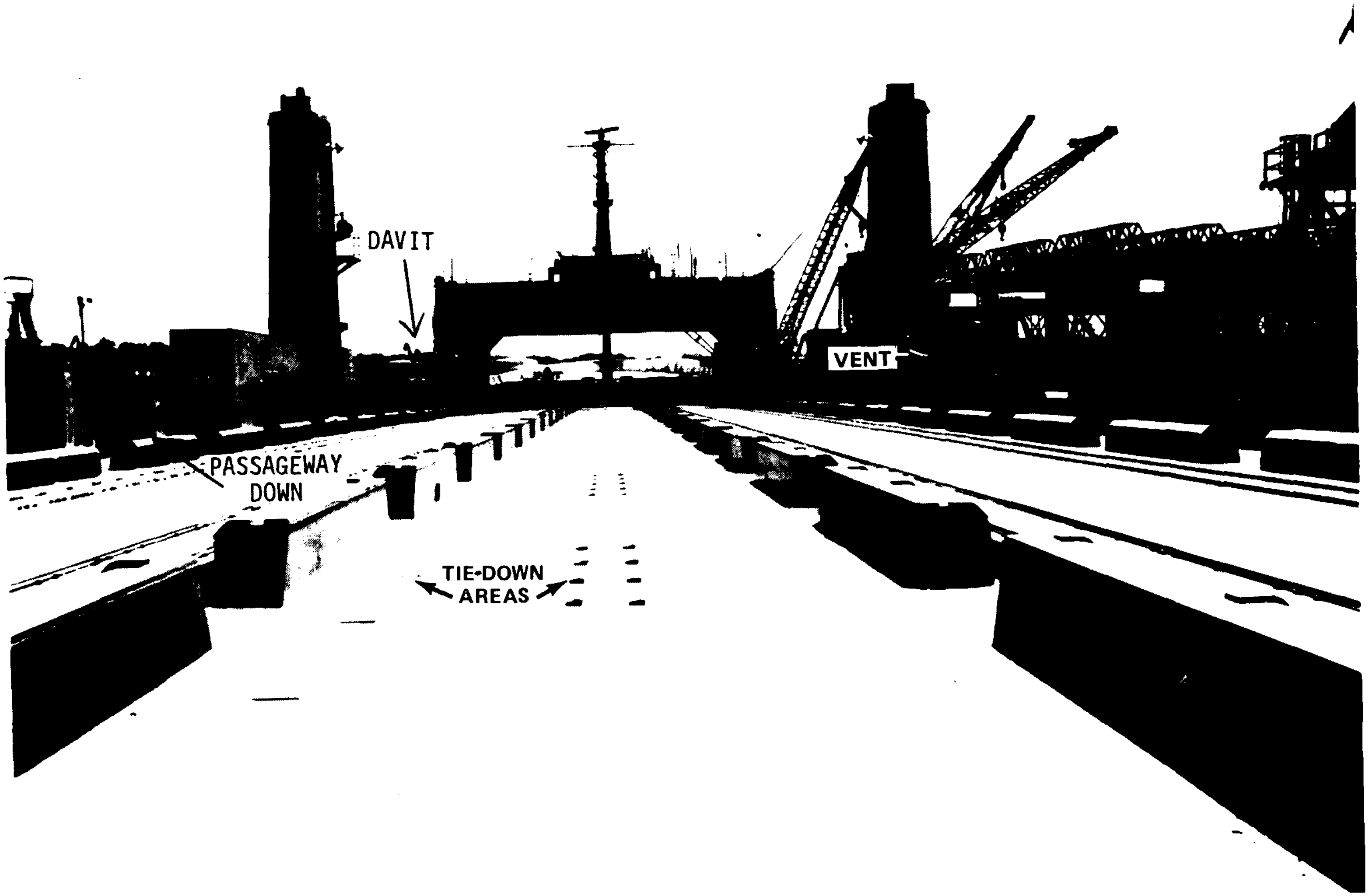

FIGURE 11. UPPER DECK STOWAGE

ELEVATOR CARGO MANEUVERABILITY

There are four constant tension barge positioning winches aboard, two on each side of the elevator well (Figure 12). They are designed to position floating barges prior to their being elevated. During normal loading operations a tug positions the barge so that approximately 50 percent of the barge's length is located over the elevator platform. At this point, lines from the constant tension positioning winches are attached and the tug is released. The winches are controlled by two operators, one for each side of the elevator platform. The two operators can manipulate the four winches and work in concert to position the barge over the submerged support pedestals on the elevator platform.

CONTAINER ADAPTOR FRAMES

To overcome the incompatibilities of LOTS equipment with the SEABEE barge handling system, it was proposed that container adaptor frames be used. These devices were designed to increase the ship's container-carrying capability (Figure 13). Each adaptor has the capacity for the equivalent of twenty-four 20-ft containers. The configuration of the adaptor permits it to be stowed upon the barge support pedestals and to be moved by the barge transporters. This feature meets the compatibility requirements for separately hoisting and stowing LOTS equipment.

An investigation of supports needed by the candidate LOTS equipment for deployment revealed that the following minimum numbers of these 30-ton adaptors are required:

- LCU (1646-class) 2
- LACV-30. 1
- DeLong B 6
- LCM8 1
- 3 x 15 Causeway. 2

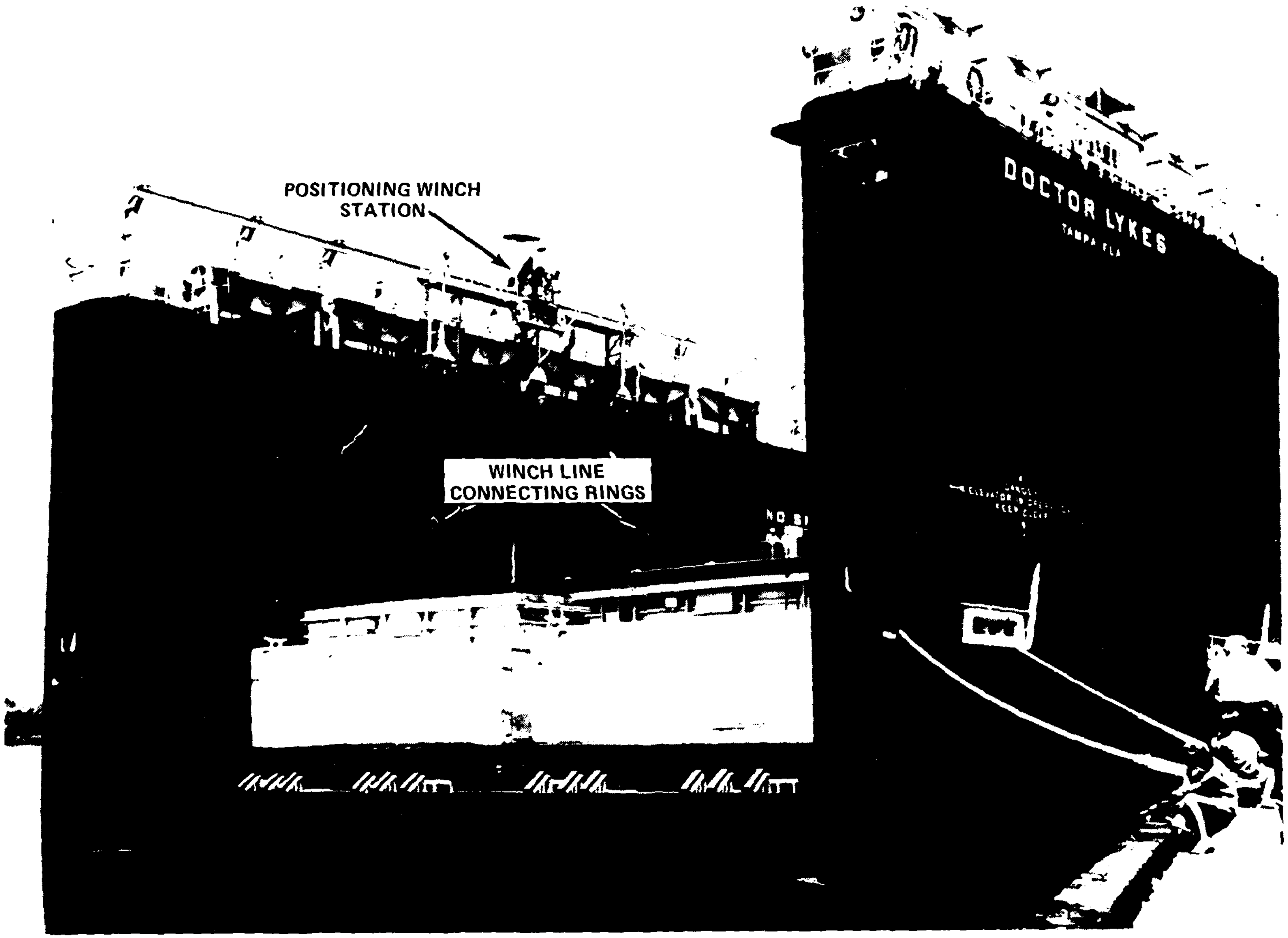

FIGURE 12. POSITIONING WINCH STATION

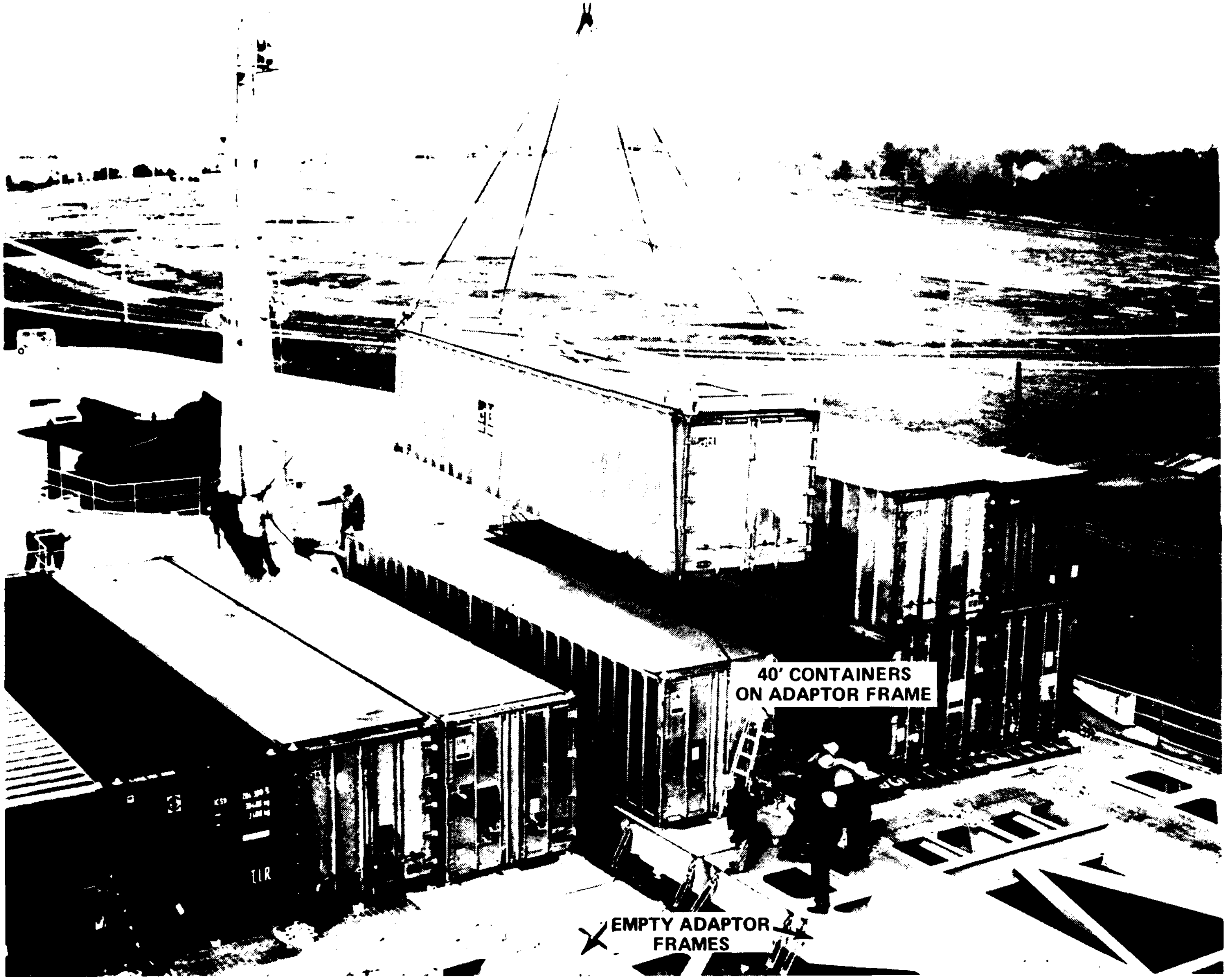

FIGURE 13. CONTAINER ADAPTOR FRAMES

The maximum number of adaptors that can be positioned on the elevator platform is four. This is sufficient to support any LOTS equipment for lift and movement to an appropriate stowage area. When required, the adaptors are positioned on the elevator platform and tied down. The elevator is submerged and equipment is floated over the adaptors. The elevator is raised to the appropriate deck where the equipment will be stowed. Tne adaptors are detached from the elevator platform and the barge transporters then move onto the elevator and under the adaptors. The transporters raise the adaptors (with the attached load) and move them to a predetermined stowage point. In the case of the DeLong B barge, two additional adaptors are required to support the barge overhang during stowage. The method of placing these additional adaptors is covered in Section III.

III. OPERATIONAL PLANNING FOR THE ORIGINAL SEABEE PRETEST

GENERAL

All of the proposed loads in Table 1 were within the designed lifting capacities of the SEABEE equipment handling system. However, the physical dimensions of these loads raised questions concerning the operational procedures required to load them aboard the ship.

The lengths of the DeLong barge and the LCUs would cause a cantilever effect on the elevator platform during hoisting operations. A similar effect would also occur with a load overhang on the transporters during deck stowage operations. Associated with this effect was the question of whether or not the structural tolerances of both the load and the equipment handling system could accommodate the imposed forces.

Also, most of the candidate loads have widths that are not compatible with the barge support pedestals. The incompatibility resulted either from widths of items less than the distance between pedestals or when the pedestals supported only non-load bearing surfaces of the item being loaded. Compatibility with these pedestals is required in order for the transporters to drive under the supported loads, lift them, and move them to stowage areas. In all cases, however, the incompatibilities were resolved by the use of the aforementioned container adaptor

frames which provided the necessary support for load movement and stowage. These frames also provided the support required by those landing craft without flat bottoms, such as the LCM8.

ELEVATOR SUITABILITY

Operational procedures for loading and stowing along with equipment modifications had to be identified and planned in order to attain a feasible deployment package. The equipment modifications were relatively minor. Equipment loading procedures are discussed later in this section. The major concerns were focused on the lift capability of the SEABEE elevator and the ability of outsized loads to withstand the lifting force.

The two major areas of potential difficulty were associated with cantilever loads due to the unsupported weight of outsized equipment extending beyond the edge of the elevator. The first of these was the uneven weight distribution of the imposed loads on the elevator hoists. The other was the ability of the structure of the load itself to withstand the bending moments imposed by the lift. An on-going study project, sponsored by the Naval Ship Research and Development Center, as part of the Container Off-loading and Transfer System (COTS) program is addressing the feasibility and techniques for loading certain equipment aboard a SEABEE vessel. Although the study has not been formally completed, the results to date indicate that all of the LOTS equipment fall within the design lift and stowage capabilities of the ship.

Because of the width of the DeLong "B" barge, both transporters would have to be used for its movement on and off the elevator. The movement of the two transporters would have to be synchronized to insure that the barge moved without crabbing. It is doubtful that operators, regardless of their familiarity with the equipment, would be able to manually synchronize the transporters throughout a lift cycle.

TCDF LOADING STRESS

The TCDF, as noted, is the only item that cannot be transported by any other ship. To determine the feasibility of loading it on a SEABEE vessel, a detailed examination was made of the expected forces from the load on the ship's elevator system. Specific forces were determined based upon the following assumptions:

- The weights and center of gravity (CG) of the crane barge components are correctly specified in their manufacturer's documentation.
- Environmental effects on the equipment is negligible.
- The crane and foundation are position as far away as feasibility from the potential barge overhang (note Figure 14).
- The overhanging portion of the barge on the elevator is kept to the minimum.
- The barge weight is symmetrically distributed.

As can be seen in Figure 14, about 1/3 of the barge extends beyond the aft end of the elevator platform. If the total lift (crane-barge and elevator platform) had a symmetrical weight distribution, the CG would shift rearward of the empty elevator's CG. However, the crane's CG offsets this imbalance to some degree.

Therefore, the forces imposed by the total lift configuration is heavier at points at the aft end of the elevator and directly beneath the crane's CG than at the total lift's CG.

A = AFT END OF ELEVATOR
B = CRANE'S CG
C = ELEVATOR'S TOTAL LIFT CG
D = FORWARD END OF ELEVATOR
E = EMPTY ELEVATOR'S CG

A > C
B > C
A ≠ B
B > D
AE = ED

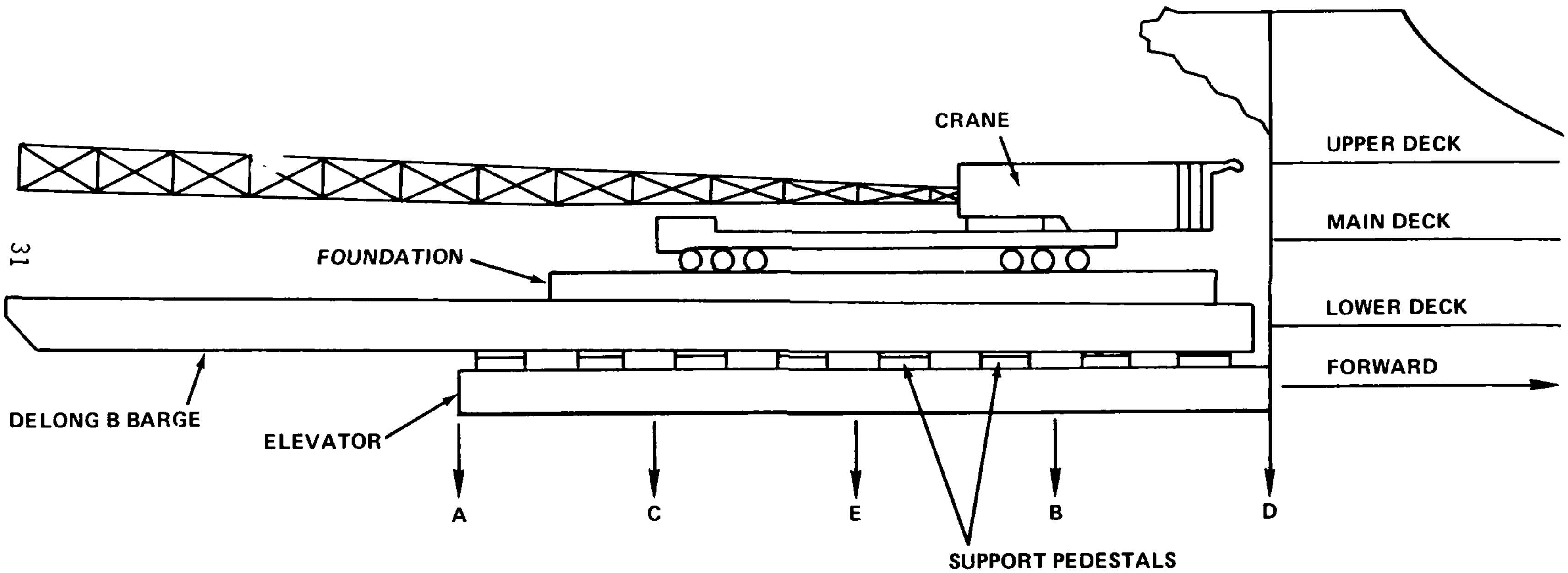

FIGURE 14. BARGE CRANE ON ELEVATOR

The unequal forces generated in lifting the TCDF were analyzed by the J. J. Henry Co., Inc. Although not linear in its effects, the overhang of the barge on the aft end of the elevator platform imposed the greatest force at Point A. A comparison of the estimate of that force to the designed capacity of the hoisting system revealed that the TCDF was within that limit. It was therefore concluded that the TCDF could be safely lifted.

When the owners derated the lift capacity of the elevator to a 1,200-long ton payload, they essentially reduced the maximum lift capacity to 336 kips for each hoist. An assumption would have to be made here that the center of gravity of the 1,200-long ton load was at the same point as the center of gravity of the elevator. Thus, if only one 1,000-long ton SEABEE barge was lifted, it would impose a force of about 412 kips on each hoist located on the outboard side closest to the barge. This is because the barge cannot be loaded on the center of the elevator and would have to be loaded on a set of pedestals thus creating an imbalance on each side for the hoists. In this case, the hoists on the side furthermost away from the barge would be exposed to a force of only about 185 kips each. (See Figure 15.) Since such single barge lifts have been done safely in the recent past,[1] it would appear that the TCDF could also be safely lifted, because the maximum imposed force on any hoist is less than 412 kips.[2] It must be concluded that the unusual nature of the TCDF load with its 50-ft overhand had a major bearing on the management decision.

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[1] Based upon information supplied by the Navy JTD Technical Manager from conversations with ship company officials.

[2] J. J. Henry Co., Inc., Feasibility Study for Shipping Crane Barges on SEABEE Vessel, 6 January 1976.

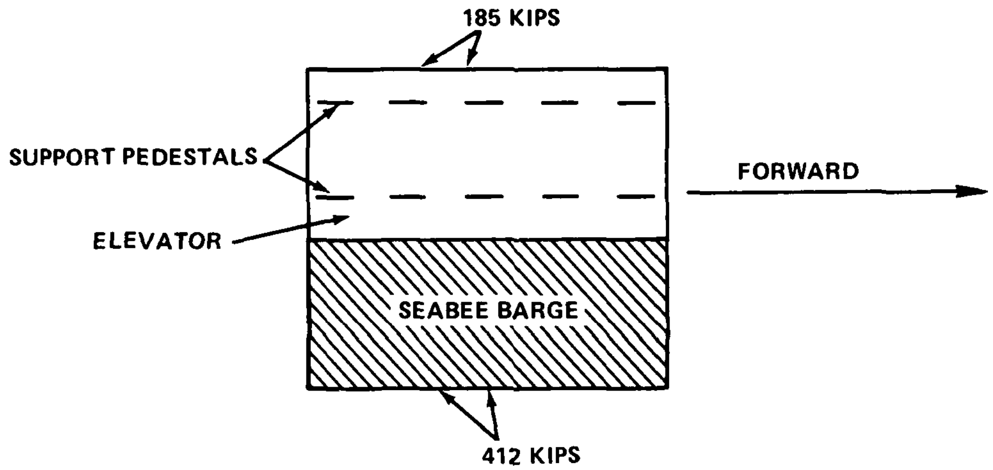

FIGURE 15. OVERHEAD VIEW OF SEABEE BARGE ON ELEVATOR

EQUIPMENT LOADING PROCEDURES

DeLong "B" Barge With Deck Mounted Crane

As can be noted from Table 4, the physical characteristics of the crane/barge are formidable from a transportability standpoint. A review of the crane/barge combined weight distribution reveals that structurally the 50-ft overhang on the elevator platform does impose a bending moment which is well below the strength factors of the hull. Therefore, the barge structure is capable of withstanding the forces imposed by the lift with the elevator.[3]

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[3] Ibid.

TABLE 4

CRANE/BARGE COMBINATION PRINCIPAL CHARACTERISTICS*

Barge Principal Dimensions		
Length	150 ft, 0 inches	
Width	60 ft, 0 inches	
Depth	10 ft, 0 inches	
P&H 6250 TC Principal Dimensions		
Length	47 ft, 6 inches	
Width	12 ft, 0 inches	
Height	13 ft, 6 inches (over lowered gantry)	
Weight		
	Long Tons	Short Tons
Barge	436.84	489.26
Crane	157.60	176.51
Foundation	61.70	69.11
TOTAL	656.14	734.88

* Refer to Figure 16 for Placement of Crane on Barge.

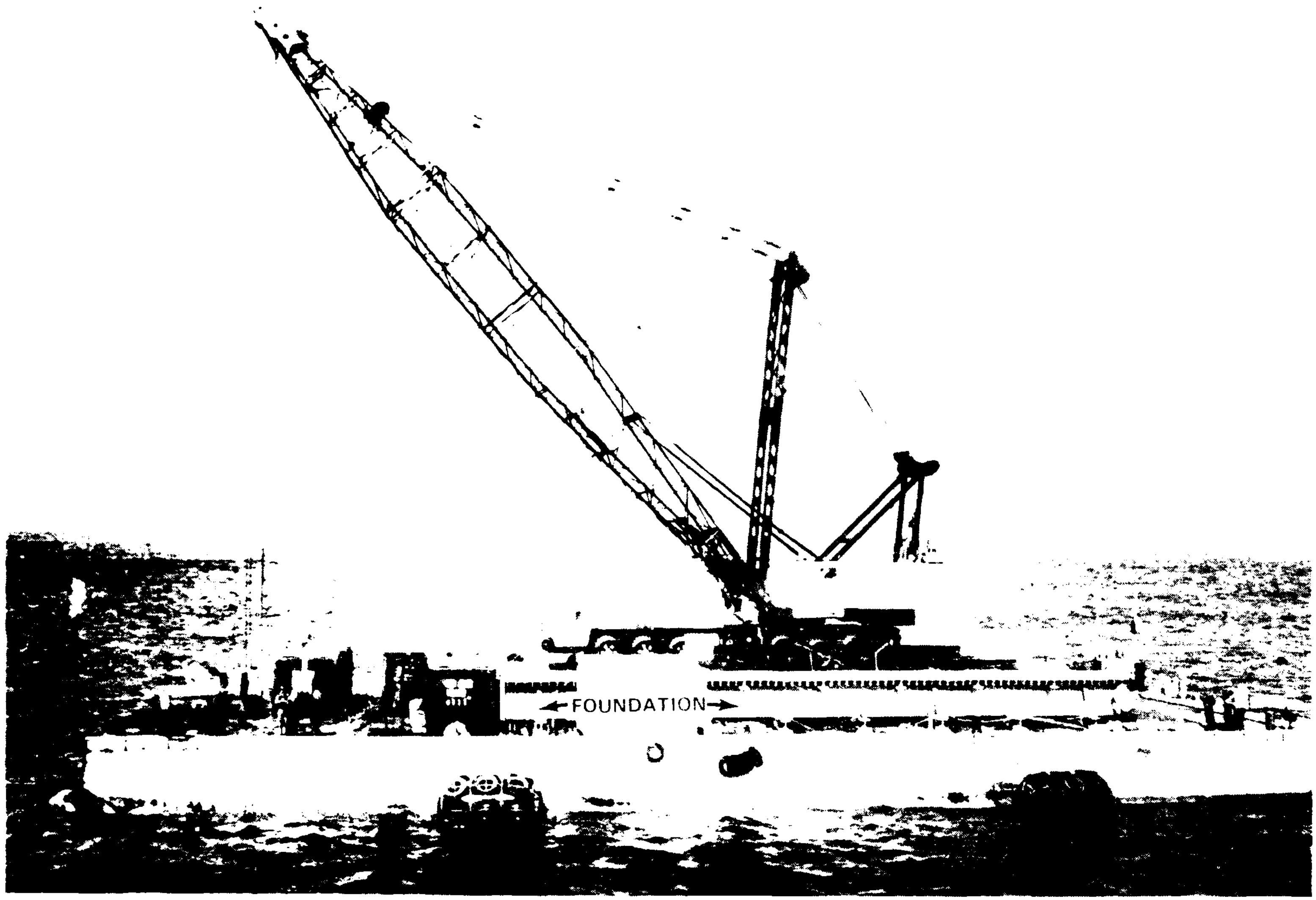

FIGURE 16. TEMPORARY CONTAINERSHIP DISCHARGE FACILITY

Other factors must be considered to overcome incompatibilities of LOTS equipment with the ship barge handling system. These factors as noted below can also be compensated by using container adaptor frames (Figure 17). If they are used to support the barge on existing support pedestals, strengthening will neither be required for stowage nor during transporter movements. However, removal of the 2½-in. corner fittings or the installation of 3-in. dunnage will be required to provide a uniform load distribution on all adaptors.

The forces imposed on the bottom of the barge by the transporter jacks were analyzed from the standpoint of the worst possible conditions. The analyses indicated that without adaptors, stresses in excess of design tolerances would occur and that internal strengthening would be required. However, such strengthening would not be required if container adaptor frames are used.

The method of loading the crane barge will be unique and is summarized as follows:

1. The elevator must be submerged to its lowest level in order to accept the barge. Preferably, four container adaptor frames will be attached to the elevator platform support pedestals. Normally, the adaptor frames are secured to the support pedestals with ½-in. wire rope between each adaptor corner and fittings on the pedestals.

2. The barge will then be positioned by tug, stern first, approximately 50 percent into the elevator well.

3. Fore and aft mooring rings from the positioning winches will be secured to the barge bitts nearest the stern and to padeyes amidships respectively.

FIGURE 17. EMPTY CONTAINER ADAPTOR FRAMES

4. The tug is released and the barge is brought completely in the elevator well with the positioning winches. The stern of the barge should be positioned 15 in. aft of the forward edge of the platform. The barge's centerline should be aligned with the ship's centerline.

5. The elevator is raised enough to inspect the barge's position on the adaptors. The outboard sides of the barge should be parallel to the outboard sides of the elevator with equal clearance on both sides.

6. Once the barge is properly positioned, the elevator may be lifted to the upper deck. Then unattach the four transporters.

7. Spacers will be required as will be seen later on the bottom of the four adaptors in a position to align with each transporter jacking platform. These spacers should have a thickness that is less than the present transporter-adaptor clearance.

8. Temporary spacers, at least 1 in. thicker than the adaptor spacers mentioned above, will also be required on the support pedestals scheduled to hold the above four adaptors.

9. The transporters then move onto the elevator and under the unattached four adaptors, lift them, and deliver them to the pedestals equipped with the temporary spacers.

10. The transporters return with the remaining two adaptors, without spacers, on the transporter jacks. These adaptors are placed immediately aft of the ones supporting the barge and under the barge overhang.

11. The original four adaptors are lifted and the temporary spacers are removed. When the barge is lowered, it should now rest evenly on all six adaptors.

12. Normal tie-down fittings can be used if only one or two barges are loaded. Additional barges will require the installation of extra fittings, because they will not be compatible with the remaining existing ones.

If only four container adaptor frames are used, extensive dunnage will be required to support the barge overhang. It would appear that the quickest and most cost effective loading system includes the use of six adaptors for each barge.

LCU Stowage - 1466 Class

- Length— 118 ft - 10 in.
- Width— 34 ft - 0 in.
- Height— 17 ft - 9 in. (knocked down configuration)
- Weight— 201.6 ST/180 LT.

The length of this load creates an overhang of approximately 20 ft. The craft can structurally withstand the bending moment caused by this cantilever attitude provided no cargo is carried in the overhanging section. Also, the lift requirements are within the designed capabilities of the elevator. The hull configuration of this class offers no structural imbalance either on the elevator platform or on the stowage deck support pedestals. Since the width of this craft is only 12 in. less than a SEABEE barge, and assuming there are no projections below the bottom of the keel, this LCU can be handled similarly to a SEABEE barge.

With the elevator positioned at the loading level, the LCU may be backed stern first onto either side of the platform. The stern should be secured about 15 in. aft of the forward edge of the elevator. The imposed load of the LCU on one side of the platform is within the tolerance of the hoisting system.

Because of its height, this craft can only be stowed on the upper deck. Since available plans show no fittings for securing the craft to the ship's deck, some means for securing the craft must be accomplished.

LCU Stowage - 1646 Class

- Length— 134 ft - 9 in.
- Width— 29 ft - 9 in.
- Height— 16 ft - 1 in. (knocked down configuration)
- Weight— 170 ST/151.8 LT.

In an independent survey conducted by the Naval Sea Systems Command, it was found that this type craft is structurally adequate to withstand the imposed weights during the proposed lifting and stowage operation. This finding was based upon the assumption that no liquid or dry cargo loads were contained within the overhanging bow section which protrudes unsupported for a distance of about 38 ft beyond the elevator platform.

The existing barge support pedestals will not align with the appropriate load bearing surfaces of the craft. Structural reinforcement of the LCU is not considered practical, however, two container adaptor frames will satisfy the load support requirements. These frames will be prepositioned on the elevator's barge support pedestals as indicated in Figure 18. (Figure 18 depicts the adaptors on the port side of the elevator, however, either side may be used.) The LCU can then be cradled upon these frames for movement and stowage on the upper deck.

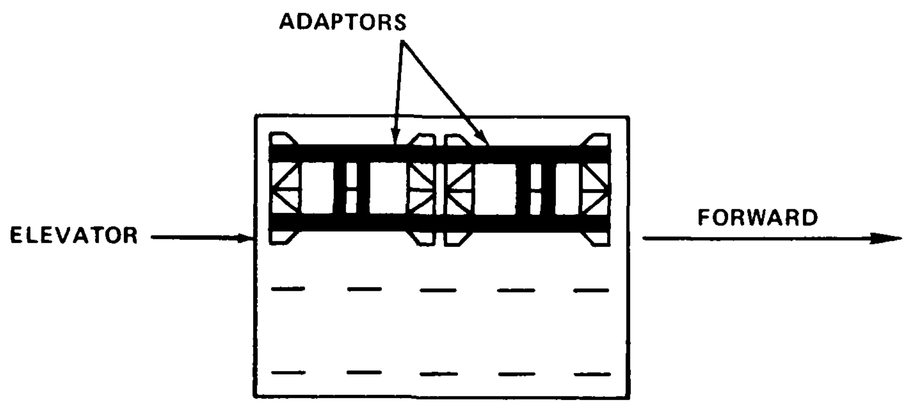

FIGURE 18. TWO ADAPTORS ON ELEVATOR

The method of positioning this class is similar to the 1466 class except that the aft end of the docking keel should be positioned so that is it supported by a structural member of the container adaptor frame. Further precautions should be taken to preclude the possibility of damage to all appendages beneath the waterline, particularly the kort nozzles and rudders.

As with the 1466 class, this LCU can only be stowed on the upper deck and will require some tie-down fabrication for sea transit.

LACV-30 Stowage

- Length— 76 ft - 3 in.
- Width— 36 ft - 8 in.
- Height— 21 ft - 6 in.
- Weight— 31 ST/27.7 LT.

In the LOTS pretest, a specific method for embarking the LACV-30 was never formally developed. The craft's dimensions are compatible with the support pedestals. However, the pedestals do not align with the load bearing surfaces of the LACV-30. One container adaptor frame will provide the necessary support for movement and deck stowage.

Prior to loading, a specially designed cradle to accommodate the four polyurethane landing pads on the craft would have to be attached to the adaptor frame. This cradle would neutralize the effects of lateral forces from the roll or pitch of the ship by positioning the landing pads into shallow sockets.

Positioning the craft over the submerged adaptor will be difficult because the skirt will interfere with visual alignment. Fenders or perpendiculars attached to the frame cannot be used due to the damage potential to the skirt or side of the craft. Paint marks on the bulkheads may assist. Minimal floating clearance may allow easier identification of platform markings. This situation may require the assistance of swimmers to physically inspect the alignment and monitor the effects of the positioning winches.

Once the LACV-30 is properly secured in the cradle, it can be elevated and stored similarly to a barge. Height restrictions dictate its positioning only on the upper deck. The only tie-downs needed (in addition to those required for cradling) will be to compensate for "negative g" forces. These tie-downs can be fastened to the forward and aft towing fittings. Note must be taken that the tie-downs must not come around the sides of the craft which are not designed to withstand the load.

LCM8 Stowage

- Length— 73 ft - 6 in.
- Width— 21 ft - 0 in.
- Height— 14 ft - 0 in.
- Weight— 65 ST/58 LT.

There are no structural problems involved with the LCM8 when a modified adaptor frame is used. Modifications can be accomplished as noted in Figure 19 or with other suitable dunnage. The adaptor should then be secured on the elevator platform about 30 ft aft of the forward edge.

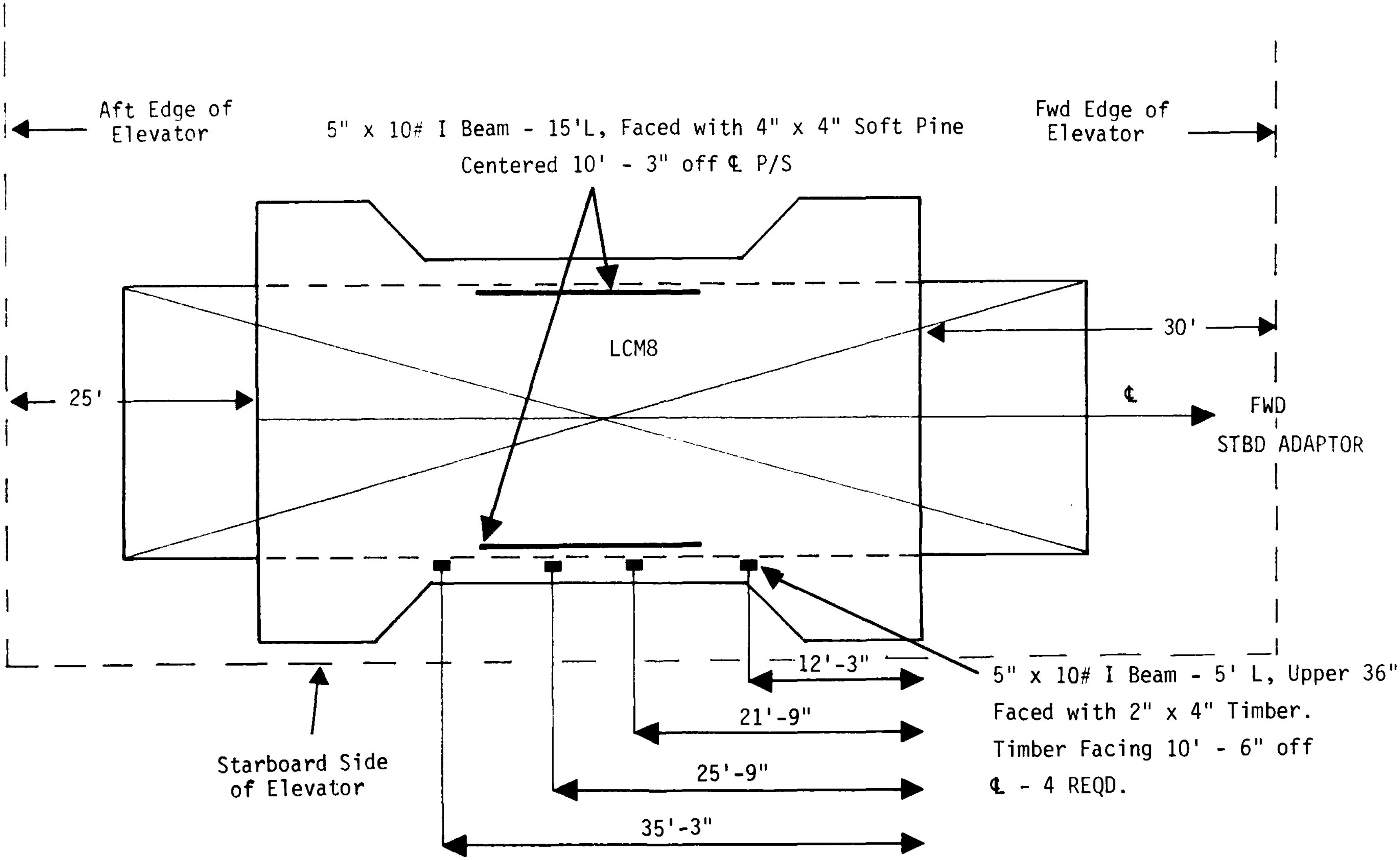

FIGURE 19. ADAPTOR MODIFICATION FOR LCM8

The longitudinally positioned 15-ft I beams, located 10 ft 3 in. off centerline will provide the optimum structural support to the underside load bearing frames of the LCM8. The four outboard perpendicular fendering members (Figure 20) will provide the correct stopping position when the winches are maneuvering the craft for final spotting. As will be seen later, proper alignment would be facilitated if a vertical stripe were painted on the side shell of the craft, 24 in. forward of frame 21.

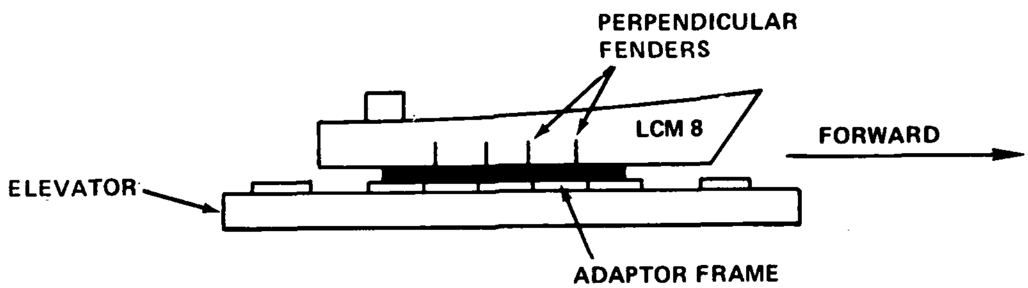

FIGURE 20. LCM8 ON ELEVATOR

Loading the LCM8 should be a relatively easy task. The platform needs to be submerged to a sufficient depth to allow the LCM8 to clear the attached container adaptor frame. The crane can enter the elevator well (bow first) to a point where the barge positioning rings from the fore and aft winches can be secured to appropriate bitts or cleats. Final positioning is accomplished by lining up the painted stripe with the second from forward fender, using the minimum 1000# tension setting on the winches.

Once the LCM8 is properly secured to the container adaptor, it can be elevated and stowed similar to a barge. There are no height restrictions, therefore, it may be positioned on any deck.

3 X 15 Causeway Stowage

- Length- 90 ft
- Width- 21 ft - 3 in.
- Height- 5 ft - 1 in.
- Weight- 67.5 ST/60.3 LT.

The causeway can structurally withstand the lifting and stowage movements when two modified container adaptor frames are used. Modifications can be accomplished as noted in Figure 21.

The longitudinally positioned 8-ft lengths of I beams, located 10 ft 3 in. off centerline, will provide the optimum structural support to the underside load bearing frames of the causeway section. The eight outboard vertical fendering members will provide the correct stopping position when the winches are maneuvering the causeway for final spotting.

Loading the causeway is similar to a barge. The elevator must be submerged to a point with at least 2 ft - 6 in. of water over the top of the adaptors. At this point the causeway is maneuvered over the elevator platform on the side opposite to the adaptors. Positioning winch taglines from the opposite (adaptor) side are secured with wire rope slings to fore and aft mooring cleats. The causeway is then warped over and hard up against the vertical fenders using the lowest tension setting (1000#) on the positioning winches.

The elevator can then be raised to the appropriate loading deck level and the adaptor restraints removed from the platform. Normal transporter operations are used to deck spot the causeway. To secure the causeway to the adaptors, 7/8-in. wire rope and 1 7/8-in. turnbuckles are required between eight deck cleats on the causeway and the "D" rings on the adaptors. The adaptors are, in turn, secured to the deck and the longitudinal bulkhead with a combination of barge tie-down fittings, wire rope and turnbuckles (four per side per adaptor).

<u>LARC-LX Stowage</u>

- Length— 62 ft - 6 in.
- Width— 26 ft - 7 in.
- Height— 15 ft - 4 in. (reduced for shipping)
- Weight— 98½ ST/88 LT.

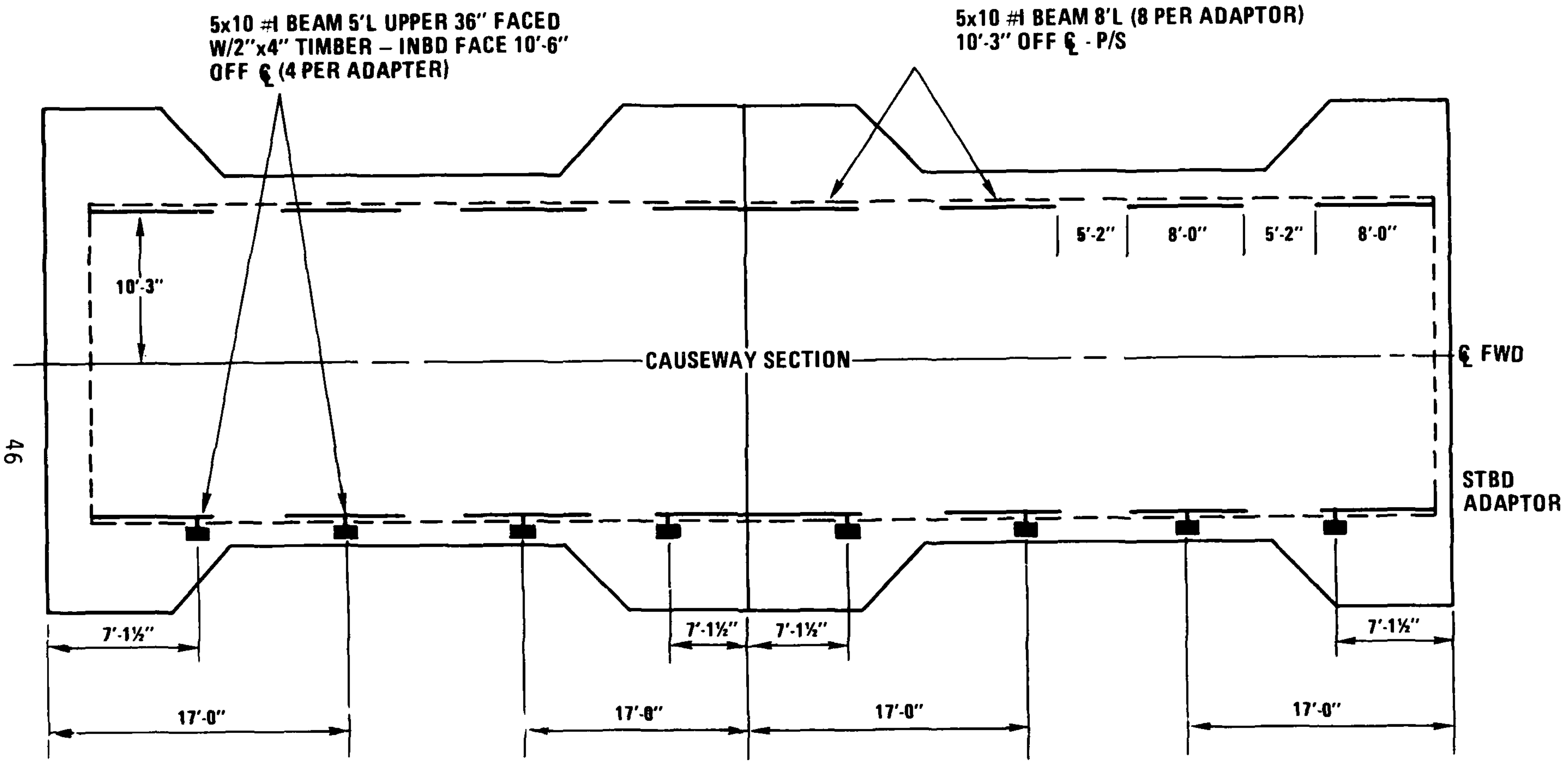

FIGURE 21. ADAPTOR MODIFICATION FOR CAUSEWAY*

*Note Figure 18 for general relationship of two adaptor frames on a SEABEE elevator.

Loading the LARC-LX is unusual in that the transporter is not required. With the elevator sufficiently submerged, the LARC-LX maneuvers itself to a position where taglines from the side to be loaded are used to attach barge positioning winch rings to suitable fittings. At this point the elevator is raised until the wheels just clear the platform. The LARC-LX is then warped until the inboard wheels bear against the inboard face of the inboard support pedestals. See Figure 22. This is accomplished using the lowest tension setting (1000#) on the positioning winches. Once secured on the platform, the LARC-LX is raised to the appropriate deck and driven to its assigned stowage point. These vehicles can be stowed on either side of any deck. The LARC-LX's wheels must straddle the barge support pedestals as shown in Figure 22. Wire rope lashings to the deck and bulkhead will be required for ocean transit.

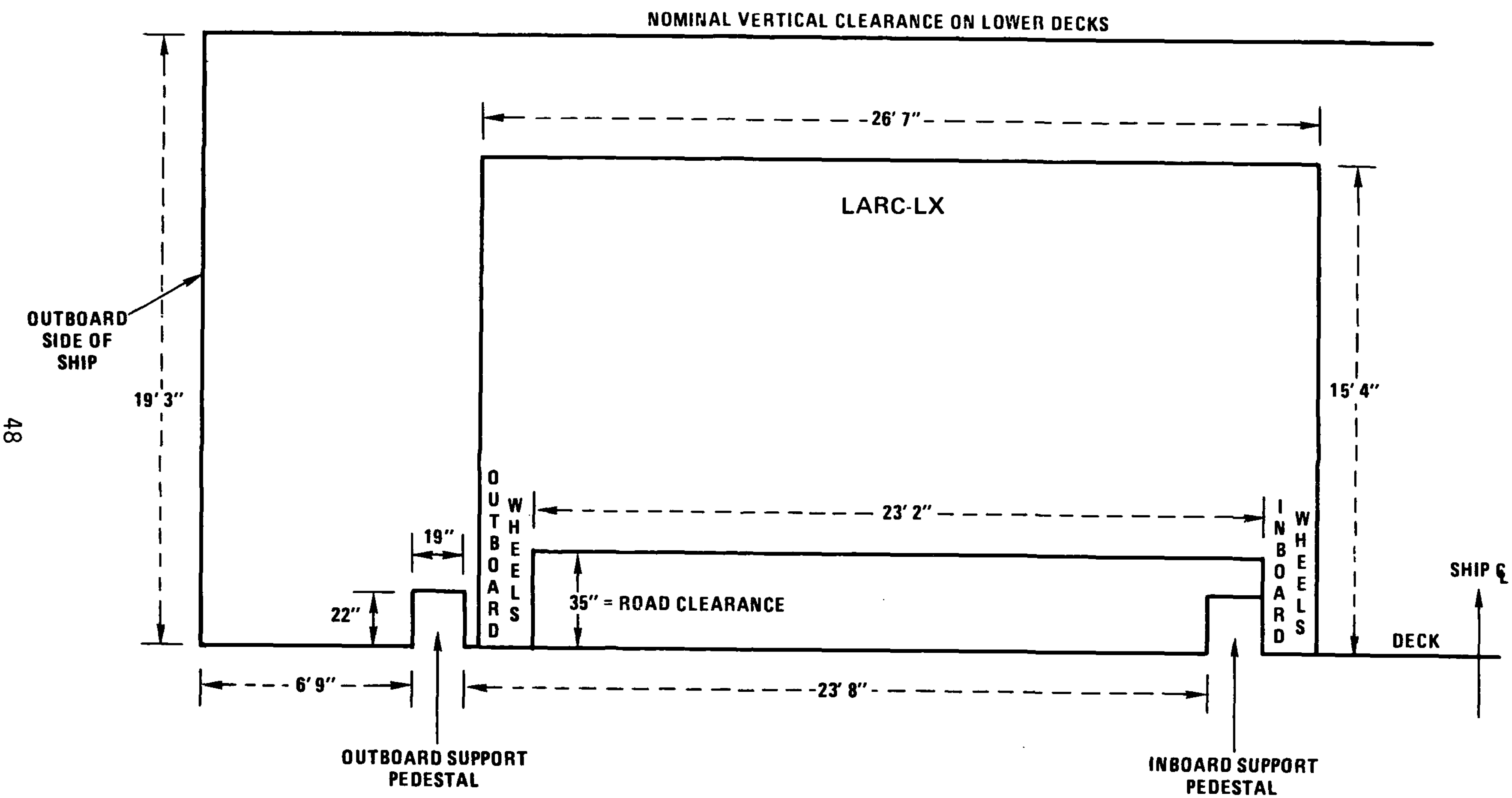

FIGURE 22. SKETCH OF LARC-LX IN STOWAGE CONFIGURATION

IV. SUMMARY

GENERAL

The results of the pretest preparations indicate the feasibility of deploying LOTS heavy, outsized equipment by a SEABEE ship after appropriate modifications are made and the prohibition against "unusual" lifts is rescinded. However, unless actions are taken well in advance of the call to use a SEABEE ship for such deployment, planners should anticipate extensive operational delays at any time a deployment is ordered and a SEABEE ship is to be used. These delays will mostly be associated with accomplishing the required modifications of the ship and equipment as well as working out detailed procedures.

A considerable amount of time and effort was spent by test planners in anticipating and addressing technical problems. Areas that received particular attention were:

- Requirement for container adaptor frames and their modifications.
- Synchronization of the barge transporters.
- Cantilevered effects on elevator hoists and the bending moments imposed on equipment.

- A loading methodology for each candidate lift.

These were not areas requiring extensive research and developmental efforts. The synchronization "kit," although not previously developed and demonstrated, appears to be within the "state-of-the-art." Its possible application in commercial use would most likely benefit the ship owner. The other areas examined were the kinds of problems that operational personnel would have to cope with in an innovative way in a contingency situation.

DELONG "B" BARGE

The barge was the driving factor for many of the issues of this pretest (cantilever affects, structural capabilities, synchronization, etc.). For planning purposes then, the suitability of the DeLong barge either as a platform for a TCDF or as a pier facility early in a LOTS operation is tenuous. There are only three SEABEE ships that can transport these barges, other than by towing. However, at present the ships are operating under limitations which preclude loading them. Even after these limitations are resolved, approximately 2 to 4 days can be anticipated to modify and prepare the ships for transporting DeLong barges.

Although the main test of LOTS will use the DeLong "B" Barge in both roles, other alternatives require investigations. For the TCDF, one possibility is the use of two Flat Deck SEABEE barges joined together. Their development into a suitable crane platform may be possible, but like the DeLong, they are tied to the availability of only three ships that can transport them.

Another alternative for the TCDF is the use of a ship, such as an LST, as a crane platform.

For pier facilities, the main LOTS test will include testing of the Navy's elevated causeway which is deployable by conventional breakbulk ships, and which may serve as an adequate facility until the DeLong barge can be towed into place, or more permanent facilities erected.

V. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The capability for employment of the SEABEE is limited at the present time due to elevator defects. Loads that either exceed the 1,200-long ton derated lift capacity of the elevator or unusual lifts such as the DeLong barge are unacceptable to the ship owners.

2. When the elevator is restored to its designed lift capability, the SEABEE should be able to transport any of the LOTS equipment.

3. Resolution of ancillary issues such as synchronization of the transporters and modifications of the container adaptor frames would minimize delays in using the ship when designed lifting capabilities are restored.

RECOMMENDATIONS

1. When the elevator is restored to its designed lift capacity, the Services should, if possible, plan for a SEABEE test patterned on the original LOTS pretest.

2. Service planners involved in strategic mobility planning and operations should be apprised of the present limitations of SEABEE vessels for deployment purposes in contingency operations.

3. Planning efforts involving LOTS operations should concentrate attention on alternatives to the DeLong "B" barges for potential as TCDF platforms and shore pier facilities at early stages of the operations.

4. If the DeLong "B" barge is found to be essential to timely LOTS operations, consideration should be given to statutory or contractual arrangement for priority usage of the SEABEE in situations demanding its special capabilities, correction or waiver of current lift limitations, development and installation of necessary ship and adaptor modifications, and preparation of Service deployment procedures.

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